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US005805334A

## United States Patent [19]

Takahashi

[11] Patent Number: 5,805,334

[45] Date of Patent: Sep. 8, 1998

## [54] CATADIOPTRIC PROJECTION SYSTEMS

[75] Inventor: Tomowaki Takahashi, Yokohama, Japan

[73] Assignee: Nikon Corporation, Tokyo, Japan

[21] Appl. No.: 858,560

[22] Filed: May 19, 1997

## [30] Foreign Application Priority Data

May 20, 1996 [JP] Japan 8-149903

[51] Int. Cl. 6 G02B 17/08; G03B 27/42

[52] U.S. Cl. 359/364; 359/727; 359/732; 359/784

[58] Field of Search 359/364, 365, 359/366, 727, 728, 732, 784

## [56] References Cited

## U.S. PATENT DOCUMENTS

4,779,966	10/1988	Friedman
5,089,913	2/1992	Singh et al.
5,592,329	1/1997	Ishiyama et al.
5,668,673	9/1997	Suenaga et al.
5,689,377	11/1997	Takahashi
5,691,802	11/1997	Takahashi
5,694,241	12/1997	Ishiyama et al.

## FOREIGN PATENT DOCUMENTS

61-156737 7/1986 Japan

63-163319	7/1988	Japan
2-66510	3/1990	Japan
3-282527	12/1991	Japan
4-234722	8/1992	Japan
5-72478	3/1993	Japan

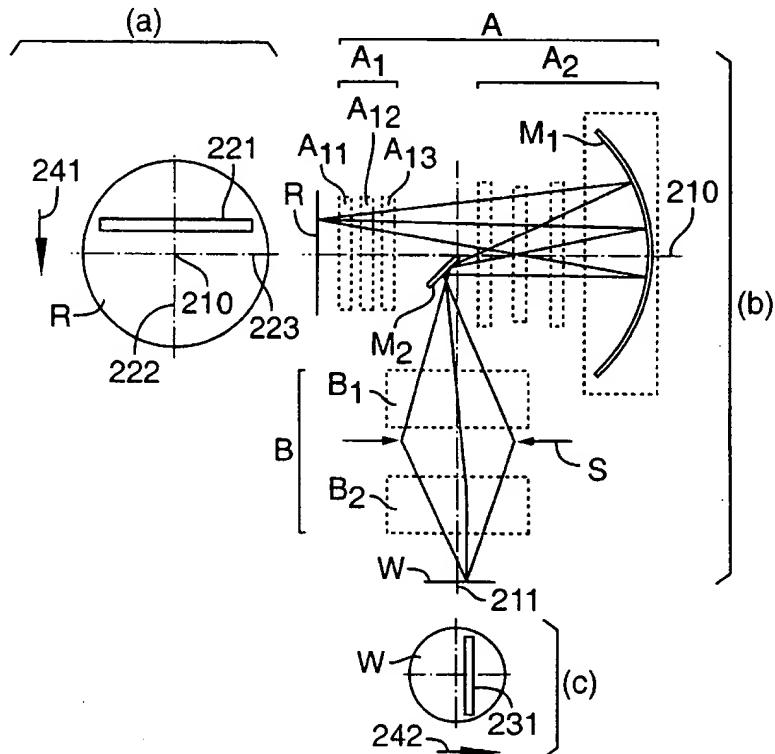
Primary Examiner—Jon W. Henry

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## [57] ABSTRACT

Catadioptric projection systems are disclosed for projecting an illuminated region of a reticle onto a corresponding region on a substrate. The systems are preferably used with ultraviolet light sources (e.g., 193 nm). The systems comprise a first imaging system, a concave mirror, and a second imaging system. The first imaging system comprises a single-pass lens group and a double-pass lens group. The single-pass lens group comprises a first negative subgroup, a positive subgroup, and a second negative subgroup. Light from the illuminated region of the reticle passes through the single-pass lens group and the double-pass lens group, and reflects from the concave mirror to pass back through the double-pass lens group to form an intermediate image of the illuminated region of the reticle. The light is then directed to the second imaging system that re-images the illuminated region of the reticle on the substrate. Alternatively, light from the single-pass lens group is reflected by a turning mirror to the double-pass lens group, wherein the light returning through the double-pass lens group continues directly to the second imaging system.

26 Claims, 5 Drawing Sheets



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*Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.*

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United States Patent

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